

S4 HYPERION AND S9 PHOEBE: TESTING A LINK WITH IAPETUS.

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Narrowband spectrophotometry taken in July, 1996, of S4 Hyperion and S9 Phoebe were obtained to address the origin of the Iapetus dark material. Iapetus has a leading dark hemisphere and a trailing bright hemisphere. The origin of this anomalous contrast has been debated, with S9 Phoebe suggested as a possible source of dark material. Hyperion has an unexpectedly low albedo for an icy moon suggesting dark material, that could have a similar origin as the Iapetus dark material, coats this satellite. Spectra of the bright and dark material of Iapetus have been successfully separated[1]. The new narrowband spectrophotometry of S9 Phoebe and S4 Hyperion do not show any compositional connection between these two objects and Iapetus.

On July 18-19, 1996, visible and near-infrared (0.40 - 0.85 μm) CCD reflectance spectra of S9 Phoebe (dispersion = 7.40 $\text{\AA}/\text{pixel}$) and S4 Hyperion (dispersion = 7.40 $\text{\AA}/\text{pixel}$), respectively, were taken at the University of Arizona Steward Observatory at Kitt Peak using the 2.25-m telescope with a cassegrain spectrograph. These spectra were ratioed to 16 Cyg B on both nights, extinction corrected, scaled to 1.0 around 0.56 μm , and a 5-point running box average performed. The data display good correlation with the ECAS photometry of Tholen and Zellner[2]. The ECAS photometry of both S9 Phoebe and S4 Hyperion were converted such that the 0.550 μm reflectance (n filter) is equal to 1.0.

Phoebe's faint magnitude has deterred the gathering of spectral information about this moon. Because of its retrograde orbit and high orbital inclination, it has long been considered likely that Phoebe is a captured object. Cruikshank[3] obtained data with JHK filters in 1979 that suggested Phoebe did not appear to be made of the same material as the dark side of Iapetus. Degewij *et al.*[4] obtained near-infrared colorimetry with results suggesting C-type material and additional low resolution spectra to support the differences between the Iapetus dark material and Phoebe.

The general shape of the S9 Phoebe spectrum suggests that it is C-class material, but the spectral

quality is not good enough to search for the smaller absorption features found in spectra of many C-class asteroids. (See Figure 1.) The spectrum of Phoebe looks quite dissimilar to the dark material spectra of Iapetus. As put forth in a model by Cruikshank *et al.*[5], there may be other fainter moons of Saturn that could contribute to the dark material seen on Iapetus (and potentially Hyperion) but based on spectral comparison only, Phoebe does not appear to be the elusive source. Because material from Phoebe could conceivably undergo alteration upon transference or arrival to Iapetus, our new data do not preclude the possibility of Phoebe as a source for Iapetus dark material.

Cruikshank *et al.*[6] gathered spectra of Hyperion in the 1.5 - 2.6 μm range and showed the presence of strong water ice bands. ECAS photometry[2] of Hyperion suggests D-type material with some indication of an absorption near the n filter. Our narrowband spectrophotometry has found no indication of this potential absorption but rather a simple D-class asteroid type spectrum. (See Figure 2.) Telluric water absorptions may be indicated at the red end of the spectrum. Though the minor absorption suggested in the broadband photometry is not repeated, the new reflectance spectrum aligns extremely well with all other points in the ECAS data. The Hyperion spectrum shows less increase in reflectance with increasing wavelength than the Iapetus dark material spectrum[1].

References: [1]Vilas, Larson, Stockstill, & Gaffey, *Icarus* 124, p.262, 1996; [2]Tholen & Zellner, *Icarus* 53, p.341, 1983; [3]Cruikshank, *Icarus* 41, p. 246, 1980; [4]Degewij, Cruikshank, & Hartmann, *Icarus* 44, p.541, 1980; [5]Cruikshank, Bell, Gaffey, Brown, Howell, Beerman, & Rognstad, *Icarus* 53, p.90, 1983; [6]Cruikshank & Brown, *Icarus* 50, p.82, 1982

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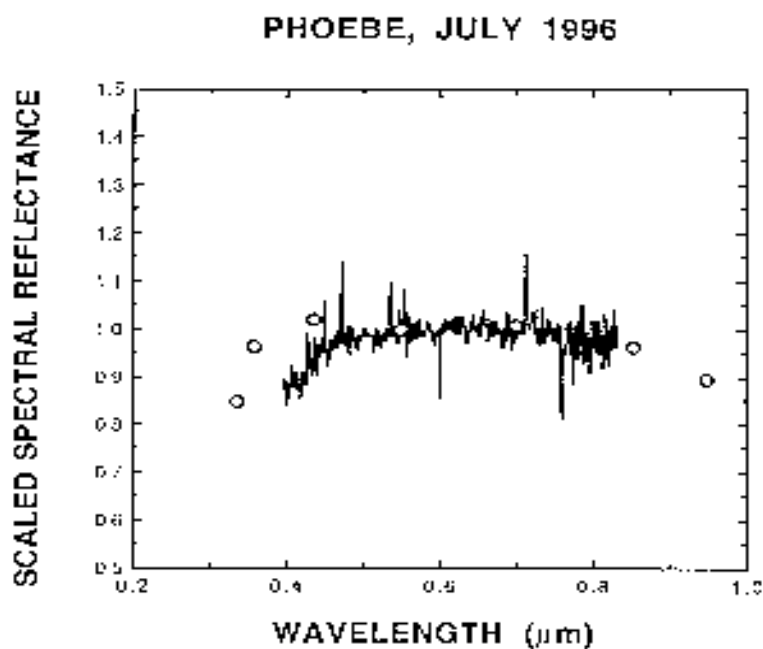


Figure 1: ECAS photometry and near-infrared reflectance spectrum of S9 Phoebe. ECAS photometry[2] was converted such that the $0.550\ \mu\text{m}$ (n filter) is equal to 1. Reflectance spectra were scaled to 1 around $0.56\ \mu\text{m}$ and ratioed to 16 Cyg B and a 5-point running box average performed.

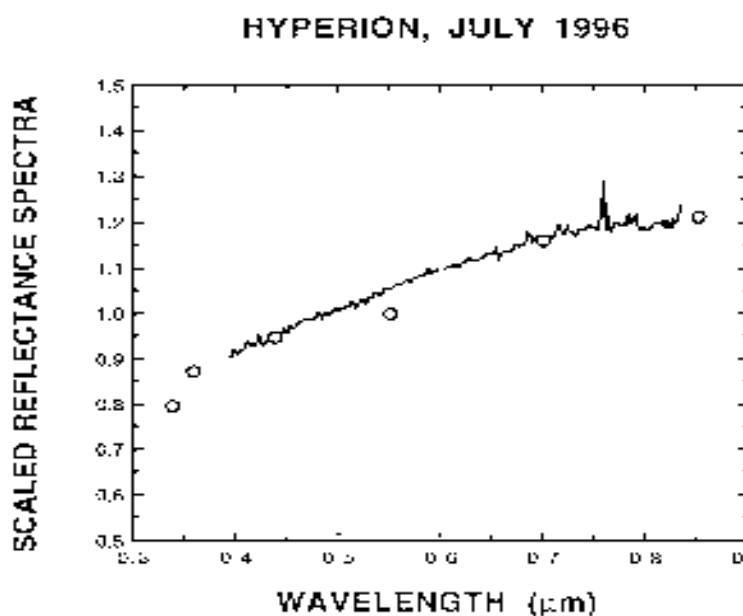


Figure 2: ECAS photometry and near-infrared reflectance spectrum of S4 Hyperion. ECAS photometry[2] was converted such that the $0.550\ \mu\text{m}$ (n filter) is equal to 1. Reflectance spectra were scaled to 1 around $0.56\ \mu\text{m}$ and ratioed to 16 Cyg B and a 5-point running box average performed.